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ABSTRACT

A resource unit on the marine sciences is described. Designed for eighth-grade students with some basic science background, the unit can be taught in a minimum of four weeks. Content includes emphasis on the biological, chemical, and physical sciences. Each lesson contains objectives, goals, materials, and follow-up activities (often an evaluation), and a bibliography. Included are the following topics: use of the microscope, chemical and physical characteristics of sea water, effects of salinity on fresh-water plants, tides, weather, waves and wave motion, and career opportunities in marine science. (CS)

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EIGHTH GRADE MARINE SCIENCE;

RESOURCE UNITS

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Introduction

I believe there is a need for marine science education at all levels of formal instruction. As the population of the world increases, man will have to develop new food sources. The ocean will become a very important part of these food sources.

I believe it is especially important to implement a marine program at the lower levels of school instruction. In keeping with this belief, I have developed a resource unit for use in the 8th grade. Students participating in this unit should have some basic science background. However, my primary purpose in development of this unit was to give the student a basic background in the marine sciences (biological, chemical and physical).

The content of this unit should be sufficient for teaching a minimum of four weeks. However, a much longer period should be spent on this unit to cover everything in detail. Much of the unit will be used in conjunction with lab exercises. This will give the student experience in developing his/her own solutions to the problems presented.

A section on career education has been included to give the student a broad overview of marine related occupations. The career education section should be conducted throughout the entire marine program.

A General Overview Of Marine Science

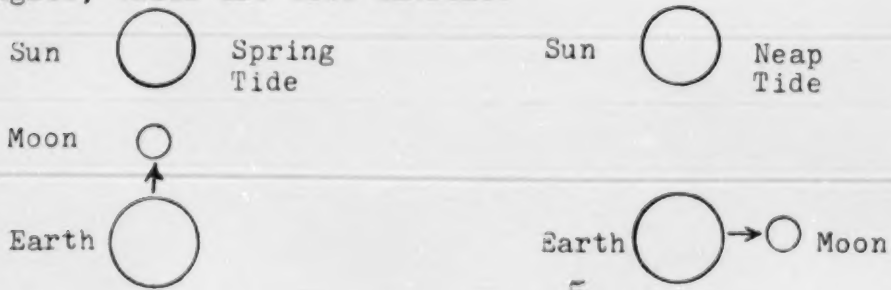
Introduction

Why should we study the sea?

The marine environment is a system that covers a very broad area in our total environment. About 72% of the earth is covered by the sea. That is nearly 3/4 of the total surface of the earth. About 61% of the northern hemisphere and 81% of the southern hemisphere is under sea water. The weight of the seas in kilograms is about 1.08×10^{21} kilograms(Explain a kilogram). In explaining a kilogram, use something that a student can relate to the total weight of the sea. Give the student a "concrete" object for comparison to a kilogram. Example: A small car would weigh approximately 9.07×10^{2} kilograms.

The United States has 1.43×10^{05} kilometers of shoreline. The world has a total of over 1.61×10^{05} kilometers of shoreline. The average height of land is about .80 kilometers above sea level. If the earth's surface was smooth, an ocean 3.2 kilometers deep would cover it.

Tides result from the gravitational pull of the moon and the sun. When the sun and the moon are in line the pull is together giving the highest and lowest tides. High tides are the highest and low tides are the lowest. When the pull is at right angles, tides are less extreme.



Tides in the Gulf of Mexico range from .3 to .6 meters, while elsewhere they range from 1.2 to 2.4 meters. In the Bay of Funday tides may rise as much as 9 to 12 meters.

Waves are different from tides. Most waves are caused by the wind. However, tidal waves are caused by earthquakes or by extremely strong winds. Waves have little effect 30 meters down, but as they move into shore the friction of the bottom causes them to rise higher until they tip foward in an arc and break. The breaker, like a minature waterfall, rushes up the beach until its energy is lost. Currents and undertows along the shore may be set up by wave action.

There are 18000 kinds of algae in the sea. Plants range from bacteria 1.02×10^{-04} centimeters long to giant kelps that grow to over 30 meters. Marine animals have about the same range in length, but the weight range is from a protozoa that weighs as little as 5.18×10^{-18} micrograms, to the great blue whale that weighs up to 1.36×10^{05} kilograms or 2.18×10^{17} times as much.

The salinity of sea water is 35 parts per thousand or about 3.5% minerals. The primary minerals in sea water are NaCl (sodium chloride), which accounts for over 75% of the mineral content. The Red Sea has 45 °/oo. These solids also include more gold than has ever been mined and enough iron to last man thousands of years.

Some Elements of Sea Water(Not a complete list):

	°/oo		°/oo
Cl	18.98	Ca	.40

Na	10.56	K	.38
Mg	1.27	Br	.065
S	.88	C	.028

Objectives

1. To introduce the student to the vastness of the marine environment.
2. To provide a general overview of marine science.
3. To introduce the student to some very basic chemical and physical properties of the marine environment.

Goals

As a result of participation in this unit, the student will be able to:

1. Appreciate the vastness of the marine environment and be able to apply the principles learned in this unit to succeeding units.

Materials

1. Several slides
2. Slide projector
3. Film screen
4. Extension cord
5. A world map to show the extent of the oceans.

Procedure

1. Prepare a few slides to use in presentation of this lesson.
2. Conduct a lecture/discussion session in which students can actively participate.
3. Use a few slides to highlight the main points covered in the

lecture/discussion session.

4. Write the weights and measurements used in this lesson on the board.
5. Explain the weights and measurements used.

Evaluation

1. What are the two major chemical elements that form the major portion of the dissolved solids in sea water? (Na and Cl)
2. What do they form when combined together? (salt)
3. Tides result from the gravitational pull of the sun and the moon. What is the position of the sun and the moon at the time of year when extreme high tides occur? Use a diagram to clarify your answer.

Suggestions for further study

1. Locate one article from a newspaper or magazine that deals with one of the subject areas introduced. Write a short summary of the article.

Bibliography

Zim, Herbert S.,Ph.D. and Lester Ingle,Ph.D. 1955. Seashores. Golden Press, New York. 160pp.

Marine Science Film

Introduction

The Restless Sea — Running time: 58 minutes

by Walt Disney — This film consists of two reels

Preview before showing to class.

Prepare a list of questions pertaining to the film.

Carry on a discussion of facts presented by the film.

Note: In situations with short class periods it might be necessary to show the film during two class sessions. This would provide more room for discussion and questions about each section.

Objectives

1. By viewing this film students should get a broad introduction to the marine environment.
2. Students should gain a better appreciation of the vastness of the oceans of the world.
3. To provide experience in taking notes from a film.

Goals

As a result of viewing this film, students will be able to:

1. Discuss some facts about what makes up the marine environment. Why is the ocean salty?
2. Discuss the basic concept of the size of the ocean as compared to the land area of the earth.
3. Discuss the concepts presented in the film from notes they have taken.

Materials

1. Film: The Restless Sea
2. Projector(16mm)
3. Projector stand

4. An extra reel
5. Film screen
6. Extension cord

Procedure

1. Preview the film and prepare a list of questions pertaining to the film.
2. Set up the film before class.

Evaluation

1. Each student should write a brief essay using their notes for reference material. Include a discussion of the marine environment as presented in the film.

Bibliography

Obtain the film from:

UMO Film Library

Shibles Hall

Orono, Maine 04473

Learning To Use The Microscope And Slides

Introduction

Learning how to use the microscope is basic in preparation for the study of the biological sciences. In the marine sciences the use of a microscope is very important if students are to gain an understanding of marine organisms. How well students use a microscope may determine the degree of understanding that is obtained from viewing microscopic marine life. In learning the basic procedures for using a microscope the students should gain a working knowledge of the parts of the microscope. As part of this unit the students shiuld also learn the proper procedures for preparation of slides.

Objectives

1. To develop observation skills.
2. To introduce students to the proper procedures for microscopic observation.
3. To introduce students to procedures used in preparation of slides.
4. To give the student a working knowledge of the microscope and its parts.

Goals

As a result of participation in this unit, the student will be able to:

1. Prepare slides for microscope viewing.
2. Set up a microscope and focus it so they get a clear view of the slide they are observing.
3. Name the various parts of a microscope.

4. Observe slides and distinguish between plants and animals.
5. Make some basic identifications of specimens present in the slides.

Materials

1. One compound microscope for each pair of students.
2. Two slides for each pair of students.
3. Two cover slips for each pair of students.
4. A quantity of pond water.
5. A quantity of sea water.
6. Lens tissue
7. Each student should be given one instruction sheet that covers:
   A. The steps to follow in correctly using a microscope.
   B. The steps to follow in preparing slides for viewing.
   C. The parts of a microscope.

Procedures

1. Prepare instruction sheets that cover:
   A. The steps to follow in correctly using a microscope.
   B. The steps to follow in preparing slides for viewing.
   C. The parts of a microscope.
2. Divide the class up into groups of two.
3. Each group should obtain one microscope, two slides and two cover slips.
4. Each group should prepare one slide using fresh water and one slide using sea water.
5. Starting with the low power objective, the student should lower the lens as low as possible without touching the slide.

The student should then very carefully focus the microscope by raising the objective(lens) away from the slide until the material comes into focus. If desired, the student can then switch to high power for more detailed viewing.

6. Observe each slide and discover the number of different organisms on each. Compare the fresh water organisms to the marine organisms.
7. Clean and dry the slides and cover slips when done.
8. Return all equipment to its proper place.

Evaluation

1. Have each student point out the parts of the microscope and discuss their respective functions.
2. Have each student discuss the correct procedures to be followed when using a microscope and slides.
3. Have each student sketch some of the organisms observed.

Suggestions for further study

1. Using reference materials available, the student should attempt to identify individual plants and animals from the slides they have prepared.
2. Have students prepare and observe additional slides to gain more proficiency in plant and animal observation.

Identification Of Salinity By Evaporation

Introduction

Sea water is different from fresh water. Sea water contains a greater amount of dissolved solids suspended in solution. The purpose of this instructional unit is to teach students how to remove these solids from solution by following evaporation procedures. In the process of conducting this exercise, the student should discover that sea water is salty and give some thought to the reasons for this.

After the evaporation procedure is completed, a comparison of the solids left in the dishes should be made. Make this comparison by weighing the petri dishes and recording the weight of each sample. Find the weight of the solids in the dishes. Compute the difference in weight between the fresh water and sea water. During a discussion of the results of the experiment, an attempt will be made to get students to explain why more solid residue was left after evaporation of the sea water, than after evaporation of the fresh water.

Objectives

1. To develop observation skills.
2. To introduce the student to the concept of solid materials suspended in a liquid.
3. To introduce the concept of evaporation.
4. To provide experience in making comparisons of dissolved solids in sea water and fresh water.
5. To provide experience in the use of the balance.
6. To provide experience in making weight measurements of

samples.

7. To provide experience in taking notes.

Goals

As a result of completing this unit, the student will be able to:

1. Discuss what makes sea water salty.
2. Discuss the basic concept of evaporation.
3. Discuss the difference in amount of suspended solids in a sample of sea water and a sample of fresh water.
4. Discuss the possible ecological effect of sea water on fresh water organisms if the ocean was to suddenly rise and expose them to sea water.

Materials

1. Two petri dishes per student
2. A marking pencil
3. A quantity of fresh water
4. A quantity of sea water
5. A single beam balance

Procedures

1. Have each student obtain and label two petri dishes.
   A. Label one: sea water
   B. Label one: fresh water
2. Weigh each petri dish before adding water.
3. Weigh each petri dish after adding the water. Use approximately equal amounts of fresh water and sea water.
4. Record the weight after each measurement.
5. Place all dishes on a window ledge or near a radiator to

evaporate the liquid.

7. After evaporation:
   A. Compare the solid matter left in each dish.
   B. Weigh each petri dish to obtain the dry weight of the solid matter.
   C. Compute the difference in weight by subtracting the weight of the fresh water solids from the sea water solids.
   D. Explain the results of this comparison. Why do the solids in sea water weigh more than the solids in fresh water?
8. Clean the petri dishes and return them to the proper storage area.

Evaluation

1. Why is there more solid residue left after the evaporation of sea water, than after the evaporation of fresh water? (There were more dissolved solids suspended in the sea water)
2. Using previous knowledge, what do you think the major solid in sea water is? (Salt or NaCl)
3. What evaporated from the petri dish? (H_2O)
4. Write a brief description of evaporation as you observed it in the process of this experiment.

Suggestions for further study

1. Using reference sources, look up the chemical elements present in most sea water.
2. Make other observations of sea water such as pH, dissolved oxygen and density. These observations depend upon the

availability of equipment to carry out the observations.

Bibliography

BSCS Green. 1973. Biological Science an Ecological Approach. 3rd. ed., Rand McNally and Co., New York: 295pp.

Vocabulary

Evaporation-the process of changing a liquid to a gas.

Comparing The Density Of Sea Water To Fresh Water

Introduction

Students will make a comparison of a sample of sea water and a sample of fresh water to observe the difference in the density of each. In making this comparison, a sample of artificial "sea water" will be necessary to give an observable difference. The artificial "sea water" should contain several times as much salt as normal sea water.

Objectives

1. To develop observation skills.
2. To introduce the student to the density difference of "sea water" and fresh water.
3. To provide experience in developing methods of measuring density.

Goals

As a result of completing this unit, the student will be able to:

1. Discuss the difference in the density of sea water as compared to fresh water.
2. Discuss the reason for the sea water having a greater density than fresh water.
3. Appreciate the concept of density and understand that density would make it easier for a swimmer to float in sea water than in fresh water.

Materials

1. Two rubber corks per student.

2. Two large test tubes per student.
3. Two thumbtacks per student.
4. Two pencils per student.
5. A quantity of fresh water.
6. A quantity of "sea water"- add extra salt for greater density.
7. Salt (454 grams)

Procedure

1. Enlarge the hole in the corks to allow a pencil to fit loosely.
2. Prepare a concentrated solution of salt and water to make "sea water" observations easier. This solution should contain 300 grams of salt to 1000 milliliters of water(300 $^{o}/_{oo}$).
3. Fill one test tube about 3/4 full of "sea water" and one test tube about 3/4 full of fresh water.
4. Place one thumbtack in the eraser of each pencil for weight.
5. Place the corks in the test tubes.
6. Place the eraser end of the pencil through the hole in the center of the cork.
7. Observe the difference in the level of each pencil.

Evaluation

1. Discuss the reason why the pencil in fresh water sinks deeper into the water than the pencil in the "sea water". Have the students relate their results in this unit to the results they obtained in the evaporation unit. What does the presence of the salt have to do with density?
2. Why does the pencil sink deeper in fresh water than in "sea water"? (The fresh water is less dense than the "sea water".)

3. What causes the greater density of the "sea water"? (salt or NaCl)

Suggestions for further study

1. Make several salt solutions of various densities and compare them to a sample of sea water using a hydrometer. Use this as a demonstration only due to the cost of hydrometers and their fragile nature.

Vocabulary

Density- the ratio of the mass of an object to its volume or the ratio of the solid material suspended in a liquid to its volume.

The Effect Of Salinity On Fresh Water Plants

Introduction

The marine environment is separated from the fresh water environment by a very thin line of overlap. In this area brackish water has more dissolved solids than fresh water, but less than sea water. This area is a transitional zone between the fresh water environment and the open ocean. If the oceans of the world were to suddenly rise there are many fresh water species that could not survive because of increased salinity.

In this unit we will study the exposure of a fresh water plant to a salt solution. We will use (Elodea) for this experiment and additionally, attempt to show the effect of a sudden increase in salinity on a fresh water plant.

Objectives

1. To develop observation skills.
2. To further the use of the microscope in making experimental observations.
3. To observe the effect of a salt solution on a fresh water plant (Elodea).
4. To provide a basis for further study of marine organisms.
5. To provide experience in taking notes of observations.

Goals

As a result of completing this unit, the student will be able to:

1. Discuss the effects of a salt solution on a fresh water plant (Elodea). What response does the plant show?

2. Discuss the effect on the environment if the ocean was to suddenly rise several feet.
3. Describe the effect of the increased salinity on fresh water plants.

Materials

1. A quantity of Elodea.
2. Two slides for each pair of students.
3. Two cover slips for each pair of students.
4. One compound microscope for each pair of students.
5. A quantity of salt solution.
6. Paper towels.
7. One eye dropper for each pair of students.

Procedure

1. Prepare several salt solutions(.5, 1.0 and 2.0 percent).
2. Conduct a group discussion in which students are given a chance to form some idea of what they think will occur when the Elodea is exposed to the salt solution.
3. Divide the class into groups of two.
4. Give each group the necessary materials.
5. Each student should prepare a slide using Elodea.
6. Place the slide under the microscope objective and focus.
7. Add a drop of salt solution to the edge of the cover slip. (Try each salt solution and compare the results)
8. Touch the opposite edge of the cover slip with a paper towel.
9. Observe the changes that occur when the salt solution makes contact with the Elodea.

10. Have the student return all materials to the proper place.

Evaluation

1. Write a short description of what you observed using the notes you took while making your observations. Use a sketch to clarify your observations.
2. Explain why you think the Elodea reacted as it did in the experiment.
3. What do you think would happen to salt water organisms when introduced to fresh water?

Suggestions for further study

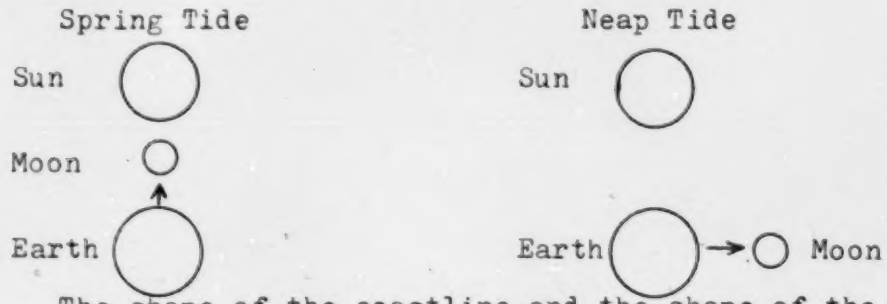
1. Set up an experiment using protozoans, water fleas, brine shrimp or small aquatic worms to demonstrate the effect of various solutions of salt water and fresh water on these organisms. Prepare a variety of solutions ranging from .5 percent to 2.0 percent salt. Note the reactions of these specimens when exposed to the various solutions.

Tides And How They Are Controlled By The Sun And Moon

Introduction

Tides result from the gravitational pull of the moon and the sun. The moon has a much stronger pull than the sun. Why? (It is much closer to the earth.) The moon exhibits about twice as much force as the sun does. When the sun and the moon are in line with earth; they have a gravitational pull that is together. This occurs when the moon is full and new.

1. High tide is highest at this time.
2. Low tide is lowest at this time.



The shape of the coastline and the shape of the ocean basin cause tidal variations.

1. Tides in the Gulf of Mexico change .3 to .6 meters.
2. Elsewhere 1.3 to 2.7 meters (Along open coasts).
3. Bay of Funday 10 to 13 meters (Funnel shaped bay).

Spring tides are exceptionally high because the sun and the moon are in line. When the tidal pull is at a right angle, tides are less extreme. Tidal variation occurs from day to day in the same place.

Objectives

1. To develop the basic concept of tides and tidal fluctuations.

2. To introduce the basic concept of gravity as related to tides.
3. To introduce the basic concept of gravitational pull caused by the moon and the sun.
4. To provide the student with experience in recognizing tides and their effect.

Goals

As a result of participation in this unit, the student will be able to:

1. Discuss the gravitational pull of the moon as related to the gravitational pull of the sun.
2. Discuss the concept of tides and why they vary in the amount of fluctuation at the location that you are observing them at.
3. Discuss the location of the sun and moon at extreme high tide and extreme low tide.

Materials

1. Several slides showing tidal variations.
2. Slide projector
3. Film screen

Procedure

1. Conduct a group discussion of tides and their influence. Include a description of the position of the sun and the moon at extreme high and low tides. Have each student draw a diagram of this situation.
2. Arrange a slide show to give the student some examples of a high and a low tide.

Evaluation

1. Write a short discussion of the position of the sun and the moon at extreme high and low tides. Use a diagram to further explain your answer.

Suggestions for further study

1. Using literary sources, look up information about tides and gravity.

Bibliography

Use the same sources used in Waves and Wave Motion.

Vocabulary

Neap tides- from an old Scandinavian word meaning "barely enough".

Observing And Recording Marine Weather

Introduction

Weather is all around us. One of our primary concerns when planning an outdoor activity is the weather. We must determine what kind of day it will be before we can effectively plan outside activities. The purpose of this unit will be to introduce the students to the weather around us.

Objectives

1. To develop weather observation skills.
2. To introduce the student to some of the most clearly discernible cloud types.
3. To provide experience in taking weather observations and keeping notes of conditions observed.
4. To provide experience using literary sources in preparation of a written report on a weather topic.

Goals

As a result of participation in this unit, students will be able to:

1. Prepare a basic weather observation of clouds, current weather, winds and temperature.
2. Have a better understanding of the evening weather patterns on the local television netwprk.
3. Make basic observations of what animals do to prepare for an approaching storm.

Materials

1. Charts showing clear pictures of the various cloud types and

formations.

2. One thermometer(Indoor/Outdoor)
3. One chart showing the Beaufort wind estimation values for wind speed.
4. A wind vane to show wind direction.
5. A set of slides showing the various cloud formations.
6. A set of charts outlining weather phenomenons: cold fronts, warm fronts, low pressure, high pressure and cloud forms associated with each.
7. Slide projector
8. Film screen

Procedure

1. Show the basic slides and charts of the clouds and weather.
2. Explain the principles of weather observation.
3. Explain weather phenomenons such as clouds, wind, current weather and temperature factors.
4. Explain how students should prepare observations.
5. Divide the class up into groups.
6. Each group should prepare a basic weather observation using equipment available. Have each group gather temperatures etc.
7. Set myself up as a consultant for weather observation problems.
8. Have each group list some observations of animals and their reactions to changing weather. Use reference sources for these.
9. Have each student prepare a written report on weather influences, of a storm on animals. (Emphasis should be on marine animals when possible.)

10. Have the class carry out the marine unit: Land And Sea Breezes

Evaluation

1. Grade the written reports for subject, content and detail.
2. Students should be able to identify the basic cloud types that have been covered. Go outside and identify clouds present.
3. Students should be able to identify the clouds that can cause dangerous weather.
4. Prepare an essay test covering the above topics. Have the class evaluate several situations using pictures and slides. Have the class describe the outcome of the weather situation given.

Suggestions for further study

1. Using skills gained in the classroom: Students will assist in setting up a simple weather observation station to use in following local weather conditions.

Bibliography

_____ 1966. Understanding Weather Maps and Reports. Editor and Engineers,LTD., New Augusta, Indiana. 1st ed. 96pp. (Glossary Pg. 96) Skillfact Library 633. Easy reading.

Marine Weather; Fronts And Pressure Systems

Introduction

In every study of weather we must consider factors that directly influence our local weather. Some of the primary weather systems we must consider are: cold fronts, warm fronts, stationary fronts, low pressure and high pressure. Without a basic understanding of these conditions and the weather that is associated with each, we cannot accurately judge the weather around us. We will also consider storms and severe weather.

Weather is a very important part of the marine environment. Everyone that works in the marine area must keep a constant check on developing weather systems. Many boats have been lost at sea because someone forgot to watch the weather. It is especially important for private craft to keep a constant check on developing weather.

The ocean plays a major role in determining the weather that affects land areas. Land and sea breezes are important in many areas. Everyone near the coast becomes concerned when a tropical storm or hurricane approaches the mainland. This is the major reason we study marine weather.

Objectives

1. To develop observation skills.
2. To introduce the basic concept of weather fronts.
3. To introduce the student to low and high pressure systems.
4. To provide experience in weather predictions as a result of observing existing conditions.

5. To familiarize students with weather conditions associated with a frontal system.
6. To familiarize students with weather conditions associated with a pressure system.

Goals

As a result of participation in this unit, students will be able to:

1. Describe weather conditions associated with weather fronts.
2. Describe weather conditions associated with weather pressure systems.
3. Prepare a very general weather prediction for one day in advance. This will of necessity be very very basic.
4. Describe the basic frontal systems.
5. Describe the basic pressure systems.
6. Continue research into frontal and pressure systems.
7. Understand television weather forecasts.

Materials

1. Charts and maps depicting frontal systems and associated conditions. (Some will be the same as the cloud unit.)
2. Colored markers for drawing frontal and pressure systems.
3. Overlays for an overhead projector.
4. Overhead projector
5. Film screen

Procedure

1. Conduct a short lecture and discussion session to explain frontal systems, pressure systems, storms and weather conditions associ-

ated with each. Include a discussion about marine weather. Introduce a hurricane and discuss its development at sea.

2. Divide the class up into groups.
3. Have each group write up a weather prediction for the following day using what they have learned.
4. Assist students on a consultant basis.
5. Reorganize the class as a whole and discuss the results of your work.
6. During the next class meeting discuss what actually happened as compared to what was predicted.

Evaluation

1. Given: A cold front approaching from the west on a hot summer day, what type of weather could you expect to observe?
2. How long would you expect it to last?
3. Given: A warm front approaching from the west during the winter, what would you expect the temperature to do? Why?
4. Given: A low pressure system forming off the Atlantic coast, in August, with favorable conditions present for further development. What do you think will occur?

Suggestions for further study

1. Read an article of your choice about a weather condition.
2. Write a short report about your chosen topic.

   Include:

   A. Type of weather.

   B. Associated conditions.

   C. Results of the weather.

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Rubin, Louis D. 1970. Forecasting the Weather. Franklin Watts, Inc. New York, N.Y. 64pp.

Career Opportunities In The Marine Sciences

Introduction

A wide variety of careers are available in the marine sciences. Career opportunities are to be found within state and federal governments. There are also many positions within private firms. Some people are also self employed in the fishing industry.

The basic principle of this unit will be to familiarize the student with opportunities that exist in the marine area. Familiarization will not be restricted to science positions alone. Students will gain knowledge that could assist them in a job search and/or in making a career decision. In a coastal community, this unit will be conducted throughout the year (Allow about 1/2 hour per week.).

Objectives

1. To introduce students to the different organizations that offer marine related employment.
2. To familiarize students with the skills required for certain positions.
3. To assist students in preparing for a career in marine employment.
4. To provide experience in locating marine employment information.

Goals

As a result of participation in this unit, the student will be able to:

1. Write a letter to an agency offering marine employment and request job information.
2. Select courses that will prepare him/her for a career in marine science.

3. Locate colleges and institutions that offer marine science programs, and understand their entrance requirements.
4. Help students in preparing themselves for vocational careers in the fishing industry.

Materials

1. Prepare marine reference materials for student use. Include a marine agency address listing.
2. Prepare a slide program outlining marine careers.
3. Sample letters for students to follow when writing for career information.
4. Slide projector
5. Film screen

Procedure

1. Conduct a short discussion on the procedures to follow when writing a letter to a marine agency.
2. Schedule several field trips to marine agencies in the local area.
3. Provide students with a source for locating marine agency listings.
4. Agency listings and types of employment:

A. Marine engineers

Development of marine equipment such as ships, submarines, diving suits and exploration equipment. Aerospace development often has practical uses in marine research and engineering. Ocean engineers also take part in preparation for off shore oil drilling and undersea mining. Employment is located with

private and federal agencies.

B. Marine biologists and oceanographers

Conduct research into the biological and life processes of the marine environment. Employment is located with state, federal and private organizations.

Federal:

Department of Commerce
NOAA
Office of Coastal Zone Management
Office of Sea Grant
National Marine Fisheries Service

State:

Department of Marine Resources
State House Annex
Capitol Shopping Center
Augusta, Maine 04333

C. Coastal Warden I

Patrols the coastal and estuarine areas for the purpose of enforcing laws established for the protection of the marine resources. Employment is with the Department of Marine Resources.

D. Other occupations:

Geologist, geophysicist, hydrologist, seismologist, ship captains, boat building(carpenters, steamfitters etc.), lobster and commercial fishermen.

E. Some colleges offering oceanographic programs are:

University of Miami
John Hopkins University

University of Hawaii

New York University

University of Alaska

University of Washington

Oregon State University

University of Rhode Island

F. Some institutions offering two year programs in oceanography:

Anne Arundel Community College

Brazosport College

Clatsop Community College

Gulf Coast Community College

Southern Maine Vocational Technical Program

State University of New York Agriculture & Technical College

Santa Barbara City College

Shoreline Community College

Stephens College

Suffolk County Community College

Evaluation

1. Students will be graded on the preparation of a letter requesting career information from a designated agency.
2. Have students write a short report on field trips taken for career orientation.
3. Students will be given credit for the presentation of a brief report on materials received as the result of their letter of inquiry.

Suggestions for further study

1. Write a brief report on one of the careers we have looked at.

Bibliography

Gaber, Norman H. 1967. Your Future In Oceanography. Richards Rosen Press, Inc., New York. 1st ed. 143pp.

_____ 1976. Vocational Opportunities In Maine: Agribusiness and Natural Resources. Cooperative Extension Service, University of Maine at Orono, Orono, Maine 04473. 598, Vol. 1.

_____ University Curricula in the Marine Sciences and Related Fields. Academic Years 1975-1976 & 1976-1977. Interagency Committee on Marine Science and Engineering. Federal Council for Science and Technology.

Write:

Director
National Sea Grant Program
NOAA
Department of Commerce
3300 Whitehaven St., Northwest
Washington, D.C. 20235

A Day At The Ocean

Introduction

A field trip will be taken to the ocean for the purpose of studying the marine area. Students will be able to observe the action of waves. The timing of the trip should be such that it is taken on a day when there is heavy wave action. This could be after a heavy storm.

Observations of a tide could also be made by spending at least one half day at the ocean. During this time the water level will change a good deal. Students will also make observations of marine weather conditions during the field trip.

Students will be expected to take into consideration the salinity and density of the ocean medium. Observations will be made of a tidal pool and the marine life contained within the tidal pools. Students should also observe the marine vegetation. Students should make collections for further study in the classroom.

Objectives

1. To develop observation skills.
2. To give the student practical experience with waves and tides.
3. To provide experience in taking field notes.
4. To provide experience in making observations of marine organisms in the natural environment.
5. To provide experience in the collection of material for further study.
6. To provide experience in caring for specimens collected for

further study.

Goals

As a result of participation in this field trip, students should be able to:

1. Discuss the effects of wave action on the marine area we visited.
2. Discuss the possible effects of tides, either incoming or outgoing.
3. Collect and translate marine weather data.
4. Discuss the relationships of marine plants and animals to their environment. Use the observations made during the field trip.
5. Explain the procedures that must be followed in caring for marine specimen collections.

Materials

1. Several small jars for collection of specimens.
2. A small cooler to keep collected specimens in.
3. A thermometer to take water temperatures.
4. A tide table.
5. A plankton net to take planktonic samples.
6. Tape to use in labeling collection jars.
7. Waterproof marking pen or crayon.
8. Field notebooks or paper for student notes.
9. Seashores by Zim.
10. The Handbook for Beach Strollers from Maine to Cape Hatteras by Zinn.
11. A hydrometer.

Procedure

1. Spend one class before the field trip; go over safety procedure and supervision.
2. Prepare all special equipment that will be used on the field trip.
3. Set up the groups that students will be in at the ocean.
   A. Outline the responsibilities of each group.
   B. Go over the procedures they are to follow.
   C. Go over procedures for making notes in the field.
4. During the field trip; conduct a group discussion and observation of the action of waves. Point out the way waves work.
5. Conduct a group discussion about tides and have students observe the difference in the level of the ocean as the tide changes.
6. Conduct a group discussion about the marine weather conditions occurring during the field trip.
7. Discuss questions as they arise. Point out that notes should be taken when conditions are observed.
8. Students should observe and record the temperature of the tidal pool.
9. Students should observe and collect specimens from the tidal pool.
10. Students should make small collections of marine aquatic plants.
11. Each group will have the responsibility for completion of certain collection and preservation procedures.
12. As part of the field trip experience, students should be taken to an area where commercial fishing craft are docked. While there, students should observe the fishing craft and meet a

fisherman. Have him explain his occupation to the class (Arrange this in advance).

Evaluation

1. Students will be expected to prepare a brief written report on the field trip experience.

Suggestions for further study

1. Have students make observations of the collected materials in following laboratory periods. Identify as many specimens as possible. Share your identifications with other members of the class.

Bibliography

Zim, Herbert S. and Lester Ingle. 1955. Seashores. Western Publishing Company, New York: 160pp.

Zinn, Donald J. 1975. The Handbook for Beach Strollers from Maine to Cape Hatteras. The Pequot Press, Chester, Conn: 128pp.

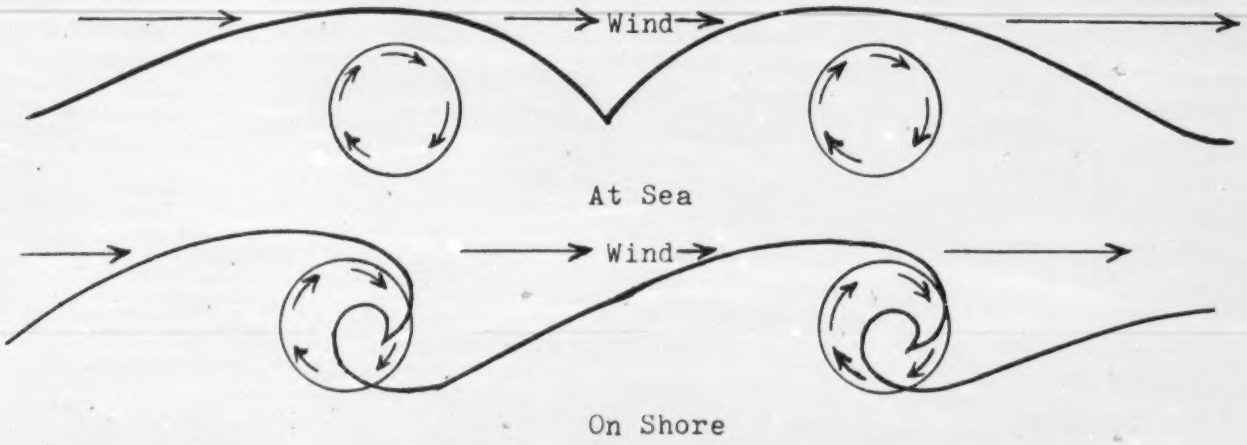
Waves And Wave Motion

Introduction

At sometime in our lives we will all be exposed to waves either directly or indirectly. Direct exposure will probably come as a result of a visit to the sea. Indirect exposure will come as a result of reading or the news media. Waves are caused by the wind, the greater the wind the larger the waves will tend to be. Wind gives the waves their rolling, rising and falling motion.

Waves would have little effect 30 meters below the ocean surface. However, in shallow water the friction of the bottom causes them to rise higher until they tip foward and break. Waves that react in this manner are called breakers. Breakers are like minature waterfalls. Breakers rush at the beach until their energy is expended. Currents and undertows can be set up by wave action.

Water Particle Motion In Waves



Objectives

1. To develop observation skills.

2. To introduce the student to the basic function of waves.
3. To introduce the student to the concept of wave motion.
4. To introduce the student to currents and undertows.
5. To provide experience in using literary sources to collect information about waves.

Goals

As a result of participation in this unit, the student will be able to:

1. Discuss the effects of waves on the beach and shoreline of an ocean.
2. Discuss the principles of wave motion.
3. Discuss the effect of currents and undertows on swimmers.

Materials

1. Colored chalk or markers for wave diagrams
2. Large sheets of paper for wave diagrams(18"X24")
3. 8mm Film loop- Waves
4. 8mm Film loop projector
5. Film screen

Procedure

1. Conduct a group discussion of waves and wave theory. Relate this to observations made on the field trip.
2. Use wave diagrams that have been previously prepared to demonstrate waves.
3. Show the film loop (Waves) and discuss the waves and wave influence shown.
4. Have the student search out literary sources for wave infor-

mation and write a short outline of material located.

Evaluation

1. Waves that are close to shore and react like minature water-falls are called? (Breakers)
2. Discuss the difference between a current and an undertow. Be specific.
3. What is the primary force that causes waves? (Wind)
4. Write a short discussion of waves and their action on beaches and shorelines.

Suggestions for further study

1. List and discuss some of the ecological effects of waves and wave action. Use literary sources to locate this information.

Bibliography

Smith, Robert Leo. 1974. Ecology and Field Biology. 2nd ed., Harper and Row, Publishers. New York:630-632.

Zim, Herbert S.,Ph.D. and Lester Ingle,Ph.D. 1955. Seashores. Golden Press, New York: 13-14.